APPENDIX G

MONITORING AND REPORTING PLAN

MONITORING AND REPORTING PLAN

GREGORY CANYON LANDFILL
SAN DIEGO, CALIFORNIA

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1.0 INTRODUCTION

This report is submitted to satisfy the requirements of Section 20385 of Title 27 of the California Code of Regulations (CCR Title 27) and the Code of Federal Regulations Title 40 (40 CFR), part 258.50 through 258.54, which requires landfill owners/operators to implement a Detection Monitoring Program (DMP) to provide best assurance of earliest detection of a release from the waste management unit. This proposed Monitoring and Reporting Program (M&RP) applies to the DMP for the proposed GCLF in San Diego County, California.

This M&RP is proposed for inclusion in the Waste Discharge Requirements (WDRs) for the proposed GCLF in San Diego County, California. The GCLF will operate as a Class III municipal solid waste facility, under the regulatory oversight of the California Integrated Waste Management Board (CIWMB) and the San Diego Regional Water Quality Control Board (RWQCB). The proposed M&RP has been prepared in accordance with CCR Title 27, and is intended to accommodate the monitoring requirements associated with development of the GCLF.

2.0 SETTING

2.1 GENERAL

The GCLF will be situated on an approximately 196-acre portion of a land parcel (including 13 acres for power pole pads) with a total area of 1,770 acres (Figure 1). The Gregory Canyon Ltd. has purchased the property and intends to reserve a minimum of 1330 acres as an environmental "buffer" and use 308 acres for landfill activities. The 308 acres will be partitioned into a 183-acre refuse area footprint, 87 acres designated as stockpile/borrow areas west of the proposed landfill footprint, 12 acres for an ancillary facilities area, 7 acres for the access road, bridge and internal haul road, and approximately 6 acres for two desilting basins.

The proposed landfill will be permitted as a Class III landfill accepting non-hazardous solid wastes and construction and demolition (inert) wastes, using the canyon and area fill method of filling. The daily maximum tonnage permitted will be a maximum of 5,000 tons per day (tpd), with a total site life of approximately 30 years. The final grading contours will reach a maximum elevation of 1,100 feet above mean sea level (amsl), for an ultimate disposal capacity of 30 million tons of refuse.

Currently, the California Environmental Quality Act (CEQA) review process has been completed with regulatory permitting being conducted in 2004. Gregory Canyon Ltd. anticipates that ancillary facilities and initial refuse cell development will be completed in 2005. The GCLF could be ready for disposal operations in 2005.

2.1.1 LOCATION

The GCLF is located in northern San Diego County, off State Route 76 (SR-76). The proposed landfill will fill Gregory Canyon, a north-draining tributary canyon to the San Luis Rey River valley (Figure 2).

2.1.2 SITE USE

Gregory Canyon is an undeveloped canyon, without a previous history of agricultural, industrial, commercial, or residential use. Since access to the site is unrestricted to animals, persons, or vehicles, likely past uses may have included recreational hiking, cattle grazing, and off-road vehicle traffic.

2.1.3 ADJACENT LAND USE

Land adjacent to Gregory Canyon is used for agriculture, dairy farming, and sand and gravel extraction. Two dairies (Lucio and Verboom) have operated to the northwest of the canyon for a number of years, on land currently leased from Gregory Canyon Ltd. The Lucio Dairy, north of the San Luis Rey River and south of Pala Road, closed in 1986, before Gregory Canyon, Ltd. purchased the property. The Verboom Dairy, which is also located south of Pala Road and west of the Lucio Dairy, closed more recently.

The Hanson sand and gravel extraction operation is located to the northeast of the site. This operation mines the alluvial deposits of the San Luis Rey River, which runs from east to west 500 feet north of the northernmost edge of the proposed landfill footprint. The active channel of the river has an elevation of 310 feet amsl, whereas the lowest point in the landfill will have an elevation of 380 feet amsl. The piezometric level at the toe of the landfill is at approximately 340 feet amsl, 30 feet above the active channel of the river.

West of Gregory Canyon there is undeveloped grassy land, while south of Gregory Canyon there is extensive acreage used for citrus and avocado orchards in the drainage basin of Couser Canyon. The Pala Indian Reservation is located to the east of Gregory Canyon and includes a portion of Gregory Mountain. Overall, the reservation land is rural, with limited agricultural and more recent commercial development, including a gaming facility, vehicle fueling station, and approximately 500-room hotel.

2.2 TOPOGRAPHY AND DRAINAGE

The proposed landfill site is located in Gregory Canyon, a north-draining tributary canyon to the San Luis Rey River valley (Figure 2). East of the canyon, Gregory Mountain rises steeply to a maximum elevation of 1844 feet (ft) amsl. The western ridge is less steep, and rises to a maximum elevation of only 940 feet amsl. The thalweg of the existing canyon drops in elevation from about 920 ft amsl at the head of the canyon on the south, to about 320 ft amsl at its northern terminus. The average slopes are about 5:1 (horizontal:vertical) near the canyon thalweg, become 2:1 at the east edge of the proposed landfill footprint, and are often 1:1 or steeper on the upper part of the eastern slope above the site. The western flank of the canyon is defined by a rounded ridgeline, with rather uniform slopes at inclinations of 2:1 to 3:1.

2.3 REGIONAL GEOLOGIC SETTING

2.3.1 REGIONAL STRATIGRAPHIC SETTING

Pre-batholithic, metasedimentary and metavolcanic rocks outcrop throughout the Peninsular Ranges. In San Diego County, outcrops include the Triassic/Jurassic Bedford Canyon sedimentary sequence and the overlying Jurassic Santiago Peak volcanics.

Late Cretaceous sedimentary rocks in the Camp Pendleton area include the largely non-marine Trabuco Formation, and the marine Williams Formation, which in the San Luis Rey and Encinitas areas, are grouped in the Lusardi and Point Loma Formations. Cretaceous rocks are not exposed in the immediate vicinity of the project site.

Post-Cretaceous rocks lie unconformably (i.e., younger strata were deposited after a period of erosion) on either the Cretaceous rocks or the crystalline basement, but are largely confined to coastal margins some distance from the project site.

In many instances, the crystalline rocks are covered by residual soils, or colluvial, and alluvial deposits. The colluvial deposits are typically located along the base of slopes and are formed as a result of the downslope movement of soil and rock by the force of gravity. The alluvial deposits are found to some degree in most drainages, with deposits of considerable thickness present in the major river valleys.

2.3.2 REGIONAL STRUCTURAL SETTING

The tectonic regime of the region has changed significantly between the time of emplacement of the intrusions of the Bonsall Tonalite and the Indian Mountain Leucogranodiorite and the present. During the Mesozoic, a subduction zone was active off the coast of California, which led to magma generation and intrusion to form these units.Tectonic conditions changed during the Cenozoic, when subduction ceased, and transform faulting began on what is now identified as the San Andreas fault system (i.e., the underthrust of the Pacific plate was replaced by lateral shear between the plates). Horizontal motion started between 25 and 20 million years ago in the San Diego region (Atwater, 1970), and since then the tectonic "grain" of the

Peninsular Ranges province has been dominated by strike-slip faulting along northwest-trending faults like the San Andreas, San Jacinto, Elsinore, and Rose Canyon faults.

The Elsinore fault zone runs about six miles northeast of Gregory Canyon, and is thus the closest of these large structural discontinuities to the site. Like the rest of the mentioned faults, the Elsinore fault zone is the result of the right-slip motion between the North American and Pacific plates.

2.4 REGIONAL HYDROGEOLOGIC SETTING

Gregory Canyon is located in the San Diego Hydrologic Basin, which occupies approximately 3,900 square miles of San Diego County and portions of Orange and Riverside Counties in southwestern California. This hydrologic basin lies within the Peninsular Ranges physiographic province of California. A relatively narrow coastal plain on the west, and rugged mountains and steep-walled, narrow valleys inland that generally trend from east to west characterizes the physiographic province.

The San Luis Rey River occupies a narrow valley in the basin that is filled with water-bearing alluvial sediments bounded by sedimentary rocks in the lower reach of the basin, and igneous and metamorphic rocks in the middle and upper reaches. The alluvial deposits along the San Luis Rey River form narrow elongated groundwater basins. The San Luis Rey Hydrologic Unit has been subdivided into three hydrologic areas from east to west, which include the Warner, Monserate and Lower San Luis (Mission). The Monserate Hydrologic Area occupies approximately the middle one-third of the San Luis Rey Hydrologic Unit and is the closest to the proposed landfill. The Monserate Hydrologic Area is further subdivided into three hydrologic subareas which include from east to west, the La Jolla Amago, Pauma and Pala Hydrologic Subareas (RWQCB 1994). Gregory Canyon is located in the Pala Hydrologic Subarea.

In this area of the site, groundwater moves from east to west, down gradient from the Pauma Basin to the Pala Basin and then to the Bonsall Basin of the Lower San Luis Hydrologic Area. The boundaries of each basin are drawn where the basement complex (hard crystalline rock) is exposed at the surface and where distinct bedrock constrictions in the San Luis Rey Valley segment the valley fill. The alluvial and colluvial deposits of the San Luis Rey River and tributary canyons, are composed mainly of coarse granular materials overlying variably weathered bedrock.

Recharge to the Monserate Hydrologic Area occurs by infiltration of precipitation, subsurface flow from the Warner Hydrologic Area, and infiltration of runoff from the surrounding mountain areas. Surface water flow in the San Luis Rey River is impounded by the dam at Lake Henshaw in the Warner Hydrologic Area, located approximately 23 miles upstream of the project area.

Because ground-water recharge is inconsistent and seasonal, historical depth-to-water measurements from the period 1965 to 1990 for the alluvial aquifer indicate that ground-water levels for a particular well may fluctuate from the ground surface to approximately 25 feet bgs in the center of the valley [California Department of Water Resources (CDWR) 1971; U.S. Geological Survey (USGS) 1990].

Colluvial deposits consisting of sediments ranging in size from clay to boulders interfinger with the alluvial sands and gravels along the basin margins, and underlie the tributary canyons as well. The alluvial deposits of the San Luis Rey River, which are composed of clay- to gravel-size material, and the colluvium occupying the basin margins and tributary canyons overlie variably weathered bedrock.

Total thickness of the alluvial sediments in the Pala Basin ranges from zero at the basin margins to in excess of 165 feet, over the proposed GCLF bridge crossing (GLA, 2000). A study by the USGS (Moreland, 1974) estimated the maximum depth of the alluvium in the Pala Basin at 244 feet (in one well 9S/2W-26G1 located in the far upper reach of the Pala Basin), and an average depth of 150 feet. At well GMW-2 (Figure 2-3), located near the southern edge of the Pala Basin at the mouth of Gregory Canyon, the thickness of alluvium is only about 50 feet (G&M 1990).

Due to an abundance of coarse sand and gravel deposits and minimal clay, the best recharge areas are located in the central and west-central portions of the basin (NBS Lowry, 1995). Reported well yields for alluvium in the Pala Basin from a study by NBS Lowry (1995) indicate rates of production range from 300 gpm to 1600 gpm. Specific capacities for alluvium along the axis of the basin range from 13 gallons per minute per foot (gpm/ft) to greater than 115 gpm/ft of drawdown (Moreland 1974). Hydraulic conductivities range from 750 gpd/ft^2 to 1000 gpd/ft^2.

Granitic and metamorphic crystalline rocks underlie the valley fill and adjacent slopes. Groundwater occurrence and movement in the bedrock medium depends upon fracture size, frequency density and interconnection, rather than matrix properties as in alluvial soils. Though it is common usage to speak of a bedrock "aquifer" (as distinct from the alluvial aquifer), wells penetrating fractures containing groundwater are not typically a dependable source of water for large-scale agricultural, municipal or industrial uses. Highly productive wells completed in bedrock are generally those located within alluvial valleys, which store groundwater that is in hydraulic connection with the underlying fracture system (San Diego County Water Authority [SDCWA], 1997).

Wells within valleys and canyons where surficial deposits are absent or minimal generally yield only small quantities of groundwater and here the bedrock aquifer may be more important for recharge to downstream alluvial aquifers. Although it is a source of recharge to the alluvial aquifer, there has been little attempt to quantify the properties of the bedrock flow system regionally and the Pala Basin as defined by the CDWR (1971) does not include the adjacent bedrock aquifer.

2.4.1 SURROUNDING WATER USES

The Porter-Cologne Water Quality Control Act and the Federal Water Pollution Control Act Amendments of 1972 require that Water Quality Control Plans (Basin Plans) be prepared for the nine state-designated hydrologic basins in the State of California. The State Water Resources Control Board (SWRCB) approved the San Diego Region Basin Plan (Basin Plan) on March 20, 1975 and an update to the Basin Plan was drafted in 1994 (RWQCB 1994). The purpose of the San Diego Region Basin Plan is to identify beneficial water uses, establish water quality objectives, implement a program to meet these objectives, and establish a surveillance program to monitor the effectiveness of the plan.

Traditionally the Pala Basin groundwater has been used for agriculture and livestock, although more recently a few commercial materials companies have been established in the basin. Pala basin groundwater provides nearly all of the potable water supply within the Pala Indian Reservation and the SLRMWD, and is used for other municipal and agricultural purposes in the basin (NBS Lowry, 1995). The largest concentration of known offsite wells in the vicinity of Gregory Canyon is in the alluvial basin of the San Luis Rey River (Pala Basin), with a few additional domestic wells serving dwellings in Couser Canyon. It is anticipated that in the future the Pala Basin groundwater within a mile of the site will be used for municipal and agricultural purposes. The USEPA has not designated the Pala Basin as a sole source aquifer. According to the interviewed operators of the orchards south of Gregory Canyon, irrigation water for these orchards is derived from the San Diego Aqueduct and not from wells.

Because ground water in the Pala Hydrologic Subarea is designated for use as domestic or municipal supply, chemical constituents in ground water must not exceed the maximum concentration limits (MCLs) specified in state and federal regulations. The primary standards are provided in California Code of Regulations, Title 22 (CCR 22), Chapter 15, Article 4, Sections 64431 and 64444, Tables 64431-A and 64444-A and the Code of Federal Regulation, Title 40, part 141. The primary standards are threshold concentrations for specific minerals and chemicals to protect human health.

The state has also developed secondary standards for constituents that may adversely affect the taste, odor or appearance of the water. These secondary MCLs are provided in the CCR 22, Chapter 15, Article 4, §64449, Tables 64449-A and -B. Groundwater in the Pala Hydrologic Subarea is also designated for use as an agricultural supply, and it should not contain concentrations of chemical constituents above these secondary standards.

2.5 LOCAL GEOLOGY

2.5.1 LOCAL STRATIGRAPHY

Various geologic units occur within the project area. In the lower portions of the canyon, a thin veneer of unconsolidated residual soils, colluvial, or alluvial deposits mantles over a substrate of weathered tonalite. Igneous intrusive and metamorphic rocks with various degrees of weathering form the topographic highs. The following subsections describe the geologic units that occur at the site in further detail.

Surficial Soils

According to Woodward-Clyde (1995), the topsoil units encountered in the area vary in thickness from about six inches to three feet, and are composed of silty sand, silty sand with clay, and silty sand with cobbles and boulders. In general, one would expect the steeper, upper slope area of the landfill site to have slightly thinner soil accumulations (0 to 6 inches) than the intermediate or lower slope areas. Underlying the topsoil are residual soil horizons or weathered rocks. The grading plan calls for removal of surficial soils over the entire footprint of the landfill.

Alluvium

Two alluvial units have been mapped at the lower elevations near the mouth of Gregory Canyon. The younger unit, Qal-1 is formed by overbank deposits from the active San Luis Rey river channel, which are interbedded with channel deposits from the Gregory Canyon drainage. These deposits are relatively thin and contain gravels, cobbles and boulders, supported by a sandy silt matrix. The older alluvial subunit, Qal-2, is a terrace remnant of older alluvium from the Gregory Canyon drainage.

The alluvial wedge pinches out to the south, before reaching the footprint of the proposed development. In other words, the buttress at the foot of the landfill, and the refuse prism, will be founded on bedrock, and not on alluvium. The wedge thickens to the north until eventually it merges with the channel deposits of the San Luis Rey River. Well GMW-2, located near the mouth of the canyon, cut through a 50-foot section of alluvial deposits before reaching the underlying bedrock.

Colluvium

Colluvium forms a veneer over most of the surface of the proposed landfill site. In most instances it consists of silty sand with rock clasts that range in size from gravel to very large boulders. Finer-grained deposits, largely devoid of rock clasts, were encountered in test pits located at the southern end of the canyon. Older colluvium was encountered in some of the test pits and consisted of clayey sand to sandy clay with varying rock content and slight to moderate cementation.

Rock clasts exposed at the surface of the colluvial veneer vary from gravel- to boulder-size material. Boulders of leucogranodiorite, some in excess of 20 feet in maximum dimension, are present along much of the eastern sideslopes. Based on borings drilled during previous investigations, it appears that boulders are extensive in the subsurface.

The thickness of the colluvial deposits in the landfill site area is highly variable. Cross-section interpretations by Geraghty & Miller (1990) show thickness variations from 2 to 50 feet. The upper slope area is likely to be underlain by thin colluvial deposits and surficial soils formed on highly weathered crystalline rock. Debris chutes and drainage channels may be locally backfilled with colluvium of moderate thickness, but in general, the upper slopes are not likely to be underlain by thick, laterally continuous deposits of colluvium. Lower slope areas are expected to be underlain by much deeper and laterally extensive colluvial deposits consisting of a matrix of silty sand and clay around larger cobbles and boulders.

The current grading plan calls for removal of surficial soil and colluvium over the entire footprint of the landfill.

<u>Bedrock</u>

The area of the proposed landfill was included in the regional map of Larsen (1948), who used the term Bonsall Tonalite to describe the rocks underlying the western ridge, and the term Indian Mountain Leucogranodiorite to describe the light-colored, bold outcrops of granitic rock underlying the eastern ridge of the site area. Larsen (1948) also mapped an intervening band of metamorphic rock along the lower slopes of the eastern ridge, which he correlated with the sedimentary Triassic/ Jurassic Bedford Canyon Formation; rocks of this unit have relict volcanic textures, however, and are probably best correlated with the Jurassic Santiago Peak volcanics.

<u>Metamorphic rocks (TJm).</u> The metamorphic rocks present along the easterly slopes of Gregory Canyon form a north-south-trending belt of older rock that was intruded by batholithic rocks. Specifically, the tonalite intruded and intermingled with the metamorphic rock, and both units were subsequently intruded by the leucogranodiorite.

The metamorphic rock band includes amphibolites and metavolcanic rocks, in some locations with migmatitic structure that resembles gneissic banding. The rocks are generally dark blueish gray, hard, and only slightly weathered. They have aphanitic to porphyroblastic textures, but relict porphyritic textures suggest a volcanic protolith for some of the units.

As mentioned above, Larsen (1948) correlated these metamorphic rocks with the Bedford Canyon Formation (a sequence of mildly metamorphosed sedimentary rocks represented by deformed slates, schists, quartzites and localized occurrences of limestone), which is widespread in the Santa Ana Mountains. At Gregory Canyon, however, there are no outcrops of slates, quartzites or marbles, and there is a preponderance of metavolcanic rocks. It seems more reasonable to correlate the Gregory Canyon sequence with the Jurassic Santiago Peak volcanics, a unit composed of metavolcanic and metasedimentary rocks exposed elsewhere in San Diego County.

Of the 183-acre refuse footprint, less than 10 acres along its eastern edge encroach over the outcrop of the metamorphic rocks.

<u>Tonalite (Kbt)</u>. The tonalite that underlies the western slopes and the central portion of the Gregory Canyon area is an extensive rock unit in the area. Larsen (1948) referred to this rock unit as the Bonsall Tonalite. The tonalite is a dark gray, phaneritic rock, with medium- to coarse crystallinity that includes a variety of related rock types such as gabbro. Other common variations noted in the tonalite are the locally veined and streaked appearance and the migmatitic fabric that is observed near the contact with the metamorphic rocks.

The rock is also characterized by rare inclusions of the metamorphic rocks, and by numerous leucogranodiorite dikes that include fine-grained aplites and coarse-grained pegmatites.

The tonalite is moderately to intensely weathered in most outcrops, although small cores of only slightly weathered tonalite form boulder knobs on the western flank of Gregory Canyon. Moderately weathered tonalite still preserves its phaneritic texture, but the weathered rock is less cohesive than the pristine rock, and the constituent minerals are slightly altered to oxides and clays, particularly along the edges. The intensely weathered tonalite has a granular texture that only vaguely recalls the original phaneritic texture, and is oxidized throughout. The constituent minerals are partially altered to oxides and clays, and disaggregate easily under pressure. Depth of weathering, as determined from exploratory drilling by Geraghty & Miller (1990), ranges between 65 feet in GMP-3 and 95 feet in GMW-2.

The tonalite comes in contact with the metamorphic rock along the easterly side slopes of Gregory Canyon, although the contact is typically covered by colluvium or obscured by surficial soils. Because the metamorphic rocks were intruded by the tonalite at a relatively high temperature (900° to 1200° C), where the contact was observed in our field investigations, it is irregular and somewhat transitional due to the effects of partial melting of the pre-existing rock. Based on its map position, as inferred from isolated outcrops of both rock types, the contact appears to dip to the east at angles of 20 to 25 degrees.

Leucogranodiorite (Kglgd). The leucogranodiorite map unit is a light-colored, biotite-bearing granodiorite that forms the prominent mountain flanking the eastern side of Gregory Canyon, outside of the footprint of the landfill. This prominent mountain is referred to as Gregory Mountain, but Larsen (1948) referred to it as Indian Mountain and to the light-colored rock as the Indian Mountain Leucogranodiorite. In hand specimen, the rock has a phaneritic texture with medium- to coarse-crystallinity, is light gray to buff, and has less than 5% dark minerals (biotite and iron-titanium oxides). Quartz, plagioclase, and potassium feldspar are the dominant felsic minerals.

Besides forming the core of Gregory Mountain, the leucogranodiorite also forms dikes that cut older units. The dikes vary in thickness from less than an inch up to five feet, and in most instances are pegmatitic. On account of their coarse crystallinity and superimposed fracturing, some dikes may constitute preferential paths of water flow.

The degree of weathering of the leucogranodiorite is generally slight, as can be inferred from the bold outcrops of Gregory Mountain. The dikes, on the other hand, vary in degree of weathering from low to moderate. Moderately weathered dikes are pervasively oxidized and have "cloudy" feldspars, but still preserve their phaneritic texture.

The main body of the leucogranodiorite is in intrusive contact with the metamorphic band midway along the easterly side slope of Gregory Canyon. The contact zone is narrow and abrupt where it can be observed, but is generally buried under talus. Based on its map position, as inferred from the abrupt change in topography, the contact is nearly vertical.

2.5.2 LOCAL STRUCTURAL GEOLOGY

Lineaments

GLA (1997) inspected historical aerial photographs in order to identify potential structural discontinuities in the area of the proposed GCLF. In the small-scale photographs (1:42,500 to 1:65,000), Gregory Canyon seems to be anomalously straight, but in the large-scale photographs it does not appear to be truly "linear".

The lineament analysis did not disclosed regional, through-going discontinuities across the footprint of the site. Likewise, geologic mapping of the site has not disclosed the existence of major faults across the footprint of the landfill, although thin shear zones of limited lateral extent have been mapped. Some of these shear zones have been annealed by granitic dikes, which demonstrates that they are Mesozoic in age.

Discontinuities at Outcrop Level

Structural discontinuities (joints, dikes) are common in the rocks that form the substrate of the canyon. Based on an extensive study of structural discontinuities in both outcrop and exploration boreholes (GLA, 1997), GLA concluded that the main orientations of discontinuity were:

	Dip direction	Strike direction	Dip angle
Direction 1	270°	360°	65°
Direction 2	90°	360°	80°
Direction 3	255°	345°	60°
Direction 4	330°	60°	65°
Direction 5	360°	90°	45°

These predominant orientations are consistent with the overall tectonic stress regime of the area, as described in the section on regional structural geology:

Discontinuities in Boreholes

In 1997, fourteen boreholes were logged with an optical borehole imaging probe (BIP) by COLOG. This technique is based on direct optical observation of the wall of the borehole and is recorded on videotape for viewing. Based on inspection of the BIP log each fracture is identified with a depth, orientation, and fracture ranking from 0 to 5, with a 0 indicating a closed feature, and 5 indicating a wide aperture fracture or fracture zone. Most of the fractures rank from 0 to 2, with only 20 fractures ranked at 3 and only two fractures ranked at 4 (GLA, 1997). A well by well summary of the BIP log data is provided in the Hydrogeologic Investigation Report by GLA (1997) along with a discussion of the cumulative results of fracture strike orientation and dip angles plotted for all of the tested wells. Additional borehole fracture analysis was performed during a supplemental hydrogeologic investigation conducted in 2004, and which included geophysical logging of nine bedrock borings with an optical televiewer (GLA, 2004). Based on review of the fracture data from both investigations, structural orientation and spatial distribution patterns of fractures in boreholes were consistent with the analysis of similar outcrop data discussed above.

Despite the relative abundance of fractures observed in boreholes, few were ultimately correlated with groundwater flow. As suggested by the ranking survey noted above, and by close examination of the borehole videotapes, most fractures are closed with no discernible aperture, or they are filled with mineralization. Fractures in the latter category are vein-like features with no apparent porosity. Some small igneous dikes and large mineral veins related to plutonic processes have been counted as fractures in several boreholes. These features are not water bearing, and would not change the results of the borehole survey were they accounted for.

Data from the surface and subsurface fracture observations indicate that while fracture density is significantly high in the bedrock, generally secondary porosity (created by open fractures) in the water-bearing zone is probably very low. Further discussion of the bedrock fractured flow system (i.e., secondary porosity) is included in Section 2.6.2.

2.6 LOCAL HYDROGEOLOGIC SETTING

The following sections describe hydrogeologic conditions at the GCLF, including surface water flow and drainage controls, and estimated groundwater gradients and flow paths.

2.6.1 SURFACE WATER FLOW

There are no permanent, natural surface water bodies, and no springs at the GCLF. Precipitation-related runoff waters from the site will be channeled into an engineered peripheral drain and debris retention basin. The desilting basin has been designed to accommodate flow from a 100-year, 24-hour frequency rain event.

2.6.2 GROUNDWATER FLOW

There are two distinct groundwater systems within Gregory Canyon. An alluvial aquifer hosted by the sediment wedge on the mouth of the canyon, and a bedrock system hosted by the fractured tonalite that forms the substrate of the canyon. The general direction of groundwater movement in both aquifers is northerly, toward the alluvial aquifer of the San Luis Rey River.

Alluvial aquifer

The alluvial wedge pinches out to the south, before reaching the footprint of the proposed development. In other words, the buttress at the foot of the landfill, and the refuse prism, will overlie bedrock or engineered fill, and not alluvium. The wedge thickens to the north until eventually merging with the channel deposits of the San Luis Rey River. Well GMW-2, located near the mouth of the canyon, cut through a 50-foot section of alluvial deposits before reaching the underlying bedrock.

Figure 3 shows the alluvial aquifer based on water level data collected on December 16, 1996, when there was measurable groundwater in the alluvial wells. This aquifer likely merges with the San Luis Rey alluvial aquifer to the north. Groundwater flow is to the north, under a gradient of about 0.045 ft/ft. Water level measurements recorded for these wells periodically between December 1996 and March 2002 indicate similar configurations of the water table over time, although more recent water level measurements obtained in 2004 indicate that the majority of the wells no longer contain measurable groundwater on which to develop groundwater contours.

Bedrock Fracture Flow System

The GCLF has 26 bedrock monitoring wells within the proposed landfill footprint and along the periphery of the site. Studies conducted to date indicate that groundwater in Gregory Canyon can be characterized as a fracture-controlled, interconnected flow system. This fracture-controlled groundwater communicates with, and recharges the alluvial water in the San Luis Rey River valley (Pala Basin), although the contributions from the bedrock are relatively minor relative to the volume of water transmitted through the alluvium.

The piezometric surface presented on Figure 4 reflects the main elements of the topography and illustrates the role of Gregory Mountain as the principal recharge area of Gregory Canyon. Derivation of a piezometric surface from wells isolated from one another by non-water bearing rock attests to the hydraulic interconnection of the fracture system. Water level measurements recorded for these wells through October 2004 show no significant variations in the piezometric surface over time (Table 1), although an overall decline in the water levels is recognized associated with a long-term regional drought. Therefore, it is concluded that the groundwater flow in the canyon is consistent over time and is thus predictable.

Both COLOG, Inc. and GLA performed cross-hole aquifer tests to quantitatively assess the interconnectivity of the bedrock aquifer. Three COLOG cross-hole tests, conducted in 1996 as part of the Phase 5 hydrogeologic investigation (GLA, 1997), documented hydraulic connectivity between the pumping and the observation wells. Based on the 167-foot capture radius documented by the pair GMP-2/ GLA-7, an initial assumption of monitoring wells spaced at an average spacing of 300 feet was considered to be reasonably expected to detect potential groundwater impacts under the proposed landfill. However, additional cross-hole testing was proposed following well construction to confirm the extent of their capture zones, and the spacing between the wells reduced as appropriate based on the pumping test data.

Subsequent to the Phase 5 hydrogeologic investigation (GLA, 1997), GLA conducted pumping tests in two wells (GLA-3 and GLA-8) to evaluate the hydraulic properties of the bedrock aquifer (GLA, 2001). Results from the first pumping test at well GLA-3 indicate that while pumping at 10 gallons per minute (gpm), the wells are in hydraulic communication to a distance of 200 feet (to GLA-13). In the vicinity of well GLA-8, located further up the canyon in unweathered tonalite, distance-drawdown analysis indicated an effective radius of influence of 250 feet from well GLA-8 when pumping at 2 gpm.

In order to provide an additional demonstration of the proposed groundwater monitoring system to effectively monitor the groundwater from the proposed landfill, GLA conducted a supplemental hydrogeologic investigation in the summer 2004, which included constructing seven bedrock wells to be used in the groundwater monitoring network at the downgradient limit of the landfill. A total of five long-term variable rate or constant rate aquifer pumping tests were performed along with three slug tests (drawdown-recovery) in bedrock wells as part of this supplemental hydrogeologic investigation (GLA, 2004).

Review of the work to date (including well test results and all drilling logs), suggests that three fracture flow domains can be identified as follows:

- A groundwater flow barrier formed by the unweathered tonalite underlying the west ridgeline;
- A low flow zone forming an extension of the west ridgeline; and
- A maximum flow zone along the axis of Gregory Canyon in the weathered bedrock zone.

As presented above, boring GLA-17, and wells GLA-4, GLA-9, and GMP-3, drilled along the west ridgeline to depths significantly below the projected equipotential surface are dry (one well, GLA 4 is recharged by a perched water condition), and other wells drilled in unweathered bedrock underlying the northern extension of the west ridgeline (in the low flow zone) recharge very slowly from relatively isolated fractures. Therefore, the west ridgeline is believed to form a groundwater flow barrier. This interpretation is included on Figure 4, which illustrates modified equipotential and water table contours based on this interpretation.

The line of wells across the mouth of Gregory Canyon inclusive of GLA-14 and GLA-12 (Figure 4) spans two bedrock domains apparently reflecting two degrees of fracture interconnectivity. Those wells east of and including GLA-13 all show a response to drawdown of other wells in that group. In contrast, wells west of GLA-13 can be characterized as representing a low flow zone, and have not been shown to respond similarly. This does not suggest that the wells in the low flow zone are isolated from each other or from wells east of and including GLA-13, since the projected equipotential surface includes all of the well data. Rather it suggests that the fraction of connected fractures within the low flow zone is less than in the bedrock domain to the east, assuming no difference in the transmissivity of the fractures. While a smaller well spacing in the low flow zone could be utilized to identify a similar drawdown response, it is not necessary to place additional wells in the low flow zone to detect contaminant transport because all fractures are recharged from the same source.

Fracture flow below the equipotential surface is west northwest from the Gregory Mountain recharge area to Gregory Canyon (Figure 4); occurs largely in the weathered zone; and is bounded by unweathered tonalite under the west ridgeline. The groundwater flow direction is effectively parallel to this groundwater flow barrier so that groundwater flowing under the landfill footprint will be brought to the line of compliance wells. Copies of the boring logs and well construction logs for wells located within the Gregory Canyon Landfill vicinity are included in Attachment 2.

2.6.3 WATER CHEMISTRY

Groundwater

Water quality data for wells in the Pala Hydrologic Subarea are sparse. One key indicator of groundwater quality is the total dissolved solids (TDS) concentration. As a result, for aesthetic reasons, the state has recommended that the TDS concentration be no greater than 500 mg/l in drinking water supplies. Currently, TDS concentrations in SDCWA imported supplies range from about 500 to 700 mg/l (SDCWA, 1997). Based on available groundwater quality data, the alluvial aquifer in the Pala Basin is good, with groundwater concentrations of TDS estimated in the range of 200 to 860 mg/l (J.A. Moreland, 1974) compared with 600 to 3,400 mg/l TDS for the Bonsall Basin, the next basin downgradient of the Pala Basi within the San Luis Rey River valley. The average TDS concentration for the Pala Basin is estimated to be 600 mg/l (NBS Lowry, 1995).

The historical groundwater chemistry database for the GCLF is limited to the data obtained for water samples collected from the exploration wells that existed at the Gregory Canyon site in October 1991 (WCC 1995), and subsequent sampling performed by GLA in August 1999, and four quarterly events beginning in December 2000. For the WCC data, TDS ranged from 379 to 1,060 mg/l, and pH ranged from 6.83 to 7.47. Only the groundwater samples from wells GMP-1, GMW-1, GMW-2 and GMW-3 met the state recommendation of 500 mg/l TDS for drinking water and beneficial groundwater use areas (RWQCB 1994).

Analytical results from groundwater samples collected by GLA from wells sited within Gregory Canyon during an August 1999 sampling event are relatively consistent with those obtained by WCC in October 1991. Specifically, samples were obtained from upgradient monitoring wells GLA-4 and GLA-5 and downgradient wells GLA-2, GLA-7 and GLA-10 (Figure 5). Three residential/production wells were also sampled within the San Luis Rey River valley. One residential well (Verboom Well No. 5) is located on the west side of the site near the Verboom residence, the second residential well coincides with the SLRMWD well #34, and the third residential well is Lucio Well #2, located on the north side of the river on the Lucio Family Dairy property.

In accordance with CCR 27 Section 20415(e)(6), GLA obtained four quarters of groundwater and surface water data from the proposed background monitoring points and wells downgradient of the proposed landfill site to evaluate background water quality values between December 2000 and December 2001. In addition, monthly water levels were measured to establish the expected highest and lowest annual groundwater elevations for the site.

Following completion of the four quarters of data, the water quality data was tabulated by well. This quarterly sampling program included collection of samples from the bedrock aquifer in upgradient (background) wells GLA-4, GLA-5, and GLA-11, and downgradient (point-of-compliance) wells GLA-2, GLA-10, GLA-12, GLA-13, and GLA-14, and from the alluvial aquifer in background (upgradient) well Lucio #2, and downgradient alluvial wells GLA-16, and SLRMWD designated well #34 (MWD #34). Samples collected from each of these wells were analyzed for the full suite of constituents of concern (COCs) provided in the Code of Federal Regulations (40 CFR Part 258, Appendix II). Included in this list of compounds are cyanide, sulfide, 20 metals, volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs), chlorinated herbicides, pesticides and polychlorinated biphenyls (PCBs). In addition, samples were submitted for indicator parameters including chloride, nitrate, sulfate, pH, and TDS.

Summaries of the analytical results obtained for each groundwater monitoring well are provided on Tables 3 through 13. Tables 14 and 15 present a comparison of the median concentrations of inorganic constituents in groundwater obtained from August 1999 (if available) and the subsequent four sampling rounds. These tables also present the detected organic compounds (averaged when a constituent was detected more than one time) for bedrock aquifer and alluvial aquifer samples, respectively.

In evaluating general water quality, the median values for each constituent were compared with currently established state and federal MCLs and San Diego RWQCB Basin Objectives. Review of the median data indicates that with the exception of chloride, TDS and nitrate, the groundwater water quality is generally good. The following table presents those median concentrations that were found to equal or exceed a currently established state or federal MCLs or basin objectives.

Bedrock Aquifer Wells
MCL Exceedances versus Median Concentration

CONSTITUENT	STANDARD	UPGRADIENT LOCATIONS			DOWNGRADIENT LOCATIONS				
General Chemistry (mg/L):		**GLA-4**	**GLA-5**	**GLA-11**	**GLA-2**	**GLA-10**	**GLA-12**	**GLA-13**	**GLA-14**
Chloride	300(4) / 500(1,3)	NA	NA	NA	450	NA	NA	NA	NA
Nitrate	15(4) / 45(1,3)	NA	18.8	NA	42.9	NA	NA	28.3	15.3
Total Dissolved Solids	900(4) / 1000(2)	NA	1120	NA	1410	NA	NA	1000	NA

NOTES: 1. California Primary Drinking Water Standards.
2. California Secondary Drinking Water Standards.
3. Federal Maximum Contaminant Levels.
4. Basin Objective – Pala Hydrologic Subarea.
NA – Not Applicable (no exceedance)

In the bedrock aquifer, comparison of the median data across the site indicates that samples from upgradient (background) wells GLA-4 and GLA-11 contained some of the lowest concentrations of most of the general chemistry constituents and several metals. Samples from downgradient well GLA-2 contained several general chemistry and metals at the highest concentrations in the bedrock aquifer wells. The samples from background well GLA-5, located at the head of the canyon, contained elevated concentrations of nitrate, and TDS, and the highest concentrations of sulfate and barium compared with the other bedrock aquifer wells. For the alluvial aquifer, the groundwater data is relatively consistent between the three sampled wells, with slightly lower concentrations measured in SLRMWD well #34.

Review of the Appendix II COC data demonstrates that no pesticides or PCBs were detected in groundwater at the Gregory Canyon site, and only one chlorinated herbicide (2,4-D) was identified once and at a trace concentration in the sample from downgradient well GLA-13. In contrast, several VOCs and SVOCs were detected one or more times in the proposed groundwater monitoring system samples. The majority of the detected VOCs are either common laboratory compounds such as acetone, carbon disulfide, and chloroform, or are constituents in hydrocarbon-based fuel (such as benzene, toluene, ethylbenzene and xylenes). Review of the quality assurance/quality control (QA/QC) blank sample data obtained with the primary samples also indicates measurable VOCs in blank samples including benzene, ethylbenzene, toluene and xylenes in the equipment and field blanks. The majority of the detected SVOCs were phthalates, which are plasticizers commonly attributed to laboratory or field contamination. Because the data obtained to date suggest only sporadic detections of VOCs and SVOCs, those identified are often attributed to laboratory/field-introduced impacts, and there are few on-site sources for these compounds, laboratory or field contamination is suspected. This conclusion will be confirmed during future quarterly sampling events (scheduled to begin during the first quarter 2004) that will be required prior to and during development of the landfill.

Surface Water

In addition to groundwater samples, surface water samples were collected in the San Luis Rey River from surface water stations SLRSW-1 (upstream of Gregory Canyon) and SLRSW-2 (downstream of Gregory Canyon). The samples were also analyzed for all of the COCs listed in 40 CFR, Part 258, Appendix II along with the metal surrogates chloride, nitrate, sulfate, pH, and TDS. Summaries of the analytical results obtained for each surface water monitoring station are provided on Tables 16 and 17. Table 18 presents a comparison of the median surface water sample concentrations obtained from August 1999 and four sampling rounds for inorganic constituents and presents the detected organic compounds (averaged when a constituent was detected more than one time).

Comparison of the surface water sample data with currently established state and federal MCLs and surface water basin objectives indicates that only the median TDS concentrations in both surface water samples exceeded the basin objective. Further review of the data indicated very little difference between the median values up and downstream of the canyon. This finding is not surprising considering the relatively undisturbed nature of the area.

2.6.4 BACKGROUND WATER QUALITY DATABASE DEVELOPMENT

As stated above, the first four rounds of background samples were submitted for analysis of the full suite of 40 CFR 258 Appendix II COCs in order to asses the general groundwater quality in the vicinity of the landfill prior to landfill construction or operation. In order to develop a statistical database of background water quality, a quarterly water quality monitoring program will begin now that construction and testing of the proposed groundwater monitoring well network has been completed (with the exception of proposed background well GLA-18). Based on guidelines obtained from the RWQCB, up to 16 data points is recommended to establish the baseline and characterize the naturally occurring water quality of the site before waste is received by the facility. The monitoring program will include collection of samples from existing bedrock monitoring wells GLA-2, GLA-3, GLA-4, GLA-5, GLA-11, GLA-12, GLA-13, GLA-14, GLA-A through GLA-G; and alluvial wells GMW-3, GLA-16, and replacement alluvial wells Lucio #2R and SLRMWD #34R. Surface water samples will also be collected within the San Luis Rey River at sample locations SLRSW-1 and SLRSW-2, to assist in establishing a background surface water quality data base. Following a significant rain event, if sufficient water is present, surface water will be obtained from a location within the mouth of Gregory Canyon at sample location GCSW-2, approximately 30 feet east of well GLA-10 (Figure 5).

Samples will be collected for the 40 CFR 258 Appendix I list of constituents including a minimum of 47 VOCs, along with the metal surrogates (chloride, nitrate as nitrogen, sulfate, pH and TDS) in lieu of the 15 heavy metals. Samples will also be analyzed for the indicator metals, calcium, magnesium and sodium. Because the site is located in an agricultural area, the samples will also be tested for chlorinated herbicides and organochlorine pesticides for a period of at least one year (four quarterly sampling events) to establish a broader baseline of water quality data for these constituents. Sampling will be conducted quarterly until a minimum of 16 data points have been obtained for each of the subject wells and surface water sampling locations. Continued quarterly sampling as the landfill is constructed should result in the collection of the RWQCB recommended 16 data points prior to waste disposal. However, once the landfill construction schedule is established, if necessary, a more accelerated sampling and analysis program (e.g., bimonthly or monthly) will be implemented to obtain the baseline data. This should represent a very robust database for intrawell statistical analysis, the most sensitive method available and appropriate for a pristine project site. The non-statistical VOC special test will be employed for VOCs detected in downgradient wells and surface water. When the landfill is constructed, sampling and analysis will be conducted in accordance with the monitoring and reporting program provided in waste discharge requirements adopted by the RWQCB.

3.0 WATER QUALITY MONITORING PROGRAM

This section identifies the basis for the proposed water quality M&RP for detection monitoring of groundwater and surface water for the back canyon area of the GCLF.

3.1 GENERAL

The Comprehensive Water Quality Control Plan Report, San Diego Region (9) (Basin Plan) was adopted by this Regional Board on September 8, 1994; superseding the previous 1975 Basin Plan. According to the Basin Plan, the GCLF is located in the Pala Hydrologic Subarea, of the Monserate Hydrologic Area (903.21). The Basin Plan establishes beneficial uses for surface water and groundwater in this Hydrologic Subarea including municipal, agricultural and industrial supply. In addition, surface water provides beneficial uses for water- and non-water-contact recreation and provides warm- and cold-water habitats to sustain aquatic organisms.

3.2 MONITORING POINTS AND POINTS OF COMPLIANCE

The following sections describe the monitoring systems proposed to evaluate groundwater conditions at the GCLF in accordance with CCR Title 27 §20405, and 40 CFR 258.51 through 258.54. Figure 5 identifies the approximate locations of proposed monitoring wells located in the San Luis Rey River valley and identified for landfill area monitoring. This section establishes the basis for the proposed water quality M&RP for detection monitoring of the bedrock fracture flow system and alluvial aquifer at the GCLF. Well selection was based on the results of the various phases of hydrogeologic investigation at the GCLF including hydrophysical logging, pumping tests, two-dimensional flow modeling, and an understanding of site conditions.

3.2.1 MONITORING SYSTEM

As a result of the hydrogeologic investigations, it is concluded that the alluvial and shallow bedrock systems are interconnected and groundwater freely communicates between them. Though the alluvial system represents the zone with the highest overall hydraulic conductivity, these materials will be removed within the landfill footprint (i.e., the landfill will be underlain by bedrock and engineered fill), and a release from the landfill is expected to be detectable in the fractured bedrock aquifer first. As a result, the monitoring system's first defense beyond the landfill liner system is the series of weathered/ fractured bedrock wells proposed along the downgradient limit of the landfill, or point of compliance (POC). All of the bedrock wells are screened across the first water bearing zone with the majority of these bedrock wells screened across the upper more weathered/fractured bedrock zone and thus the more highly conductive portion of the fractured bedrock flow system. However, a dual detection monitoring system, which includes dedicated wells in both the alluvial and bedrock groundwater systems, is proposed.

The detection monitoring program will include downgradient wells to collect representative samples of groundwater at the POC, and upgradient wells to collect samples of groundwater that are representative of "background" conditions. As currently proposed, with the exception of the spacing between wells GLA-14 (west of the landfill) and GLA-A, the wells are spaced about 50 to 240 feet apart, with a higher density of wells (closer spacing) along the western ridge saddle area of the site (wells GLA-A, GLA-D, GLA-E, GLA-F, and GLA-2) where there are fewer interconnected water bearing fractures. Wells GLA-14 and GLA-A, which are currently constrained by the SDCWA aqueduct easement are spaced approximately 400 feet apart. Cross-hole testing performed following well construction demonstrates that the proposed monitoring network will be able to provide the earliest detection of a release of waste constituents to ground water from the proposed solid waste management unit at Gregory Canyon. The results of the recent well testing are provided in a supplemental hydrogeologic investigation report (GLA, 2004). As an additional groundwater system enhancement, each of the bedrock POC wells will be equipped with a dedicated pump and plumbed to convey groundwater to an on-site tank. In this way, a hydraulic barrier will be maintained along the POC and capture the groundwater as it flows to the POC. Figure 5 presents the proposed locations of water quality detection monitoring points and the detection monitoring program monitoring system is summarized in the following table.

Gregory Canyon Landfill
Detection Monitoring Program

Monitoring Point	Unit	Monitoring Point I.D.	Status
Groundwater Monitoring Well	Bedrock Aquifer	GLA-4, GLA-5, GLA-11, GLA-18*	Background/ Cross-gradient
Groundwater Monitoring Well	Bedrock Aquifer	GLA-2, GMW-1, GLA-12, GLA-13, GLA-14, GLA-A, GLA-B, GLA-C, GLA-D,GLA-E, GLA-F, and GLA-G	Compliance
Water Level Measuring Station	Bedrock Aquifer	GLA-1, GLA-3, GLA-7, GLA-8, GLA-10	Not Applicable
Groundwater Monitoring Well	Alluvial Aquifer	Lucio #2R	Background
Groundwater Monitoring Well	Alluvial Aquifer	GMW-3	Compliance
Groundwater Monitoring Well	Alluvial Aquifer	GLA-16, SLRMWD #34R	Sentry
Surface Water Station	Gregory Canyon	GCSW-2	Compliance
Surface Water Station	San Luis Rey River	SLRSW-1	Background
Surface Water Station	San Luis Rey River	SLRSW-2	Compliance

Gregory Canyon Landfill
Detection Monitoring Program (Cont'd)

Monitoring Point	Unit	Monitoring Point I.D.	Status
Subdrain	Facilities Area	GCSD-1	Compliance
Drainage Layer Tank	Facilities Area	DL-1	Compliance
LCRS Tank	Facilities Area	LCRS-1**	Compliance

*Proposed well to be constructed.
**Sampled in October each year.

Groundwater Monitoring Points – For the bedrock aquifer, POC groundwater monitoring wells include GLA-12, GLA-13, GLA-14, GLA-2, GMW-1, and GLA-A through GLA-G as shown on Figure 5. Wells GLA-1, GLA-3, and GLA-10, will be utilized as water level measuring station and as contingency monitoring wells. In addition, though wells GLA-7 and GLA-8 are located within the future landfill footprint, they will also continue to be used as water level measuring stations until landfill development reaches their location, at which time they will be properly abandoned.

Existing wells GLA-4, GLA-5, GLA-11, and proposed well GLA-18 (located on the east side of the landfill footprint) will be background wells. Of these wells, the only well that cannot be constructed prior to landfill operations is GLA-18. Because of the steep slopes, access to this well location is not anticipated until the landfill operations extend a significant distance up the canyon and the utility pad is constructed. Until that time, a drill rig will not be able to gain access to the area for well construction.

In response to concerns regarding the continuity of the groundwater barrier along the western ridge of Gregory Canyon and the potential for "short-circuits", additional geologic monitoring of the tonalite barrier will be required during excavation of the western landfill subgrade to identify and mitigate potential water bearing fractures. During the excavation of each phase of the proposed unit, the subgrade will be mapped with the purpose of identifying any potentially through-going and non-interconnected fractures or faults. Upon completion of the excavation and prior to landfilling in that phase, an As-Built Geologic Report will be prepared by a California Registered Geologist and included in the final CQA certification report. This As-Built Geologic Report will include a detailed fracture and fault analysis (including stereoplots as appropriate) sufficient either to: 1) conclude that through-going disconnected fractures do not exist, or 2) recommend a method of mitigating any such fractures or faults that are identified. At a minimum, to be identified as a problematic structure, a fault or fracture should be traceable across the entire as-built cut slope of the western (tonalite) ridge, exhibit an open aperture capable of transmitting significant groundwater (i.e., a sustained discharge of 1 gallon per minute) and be disconnected from other fracture systems that would carry flow toward the thalweg of Gregory Canyon. If a through-going and non-interconnected fracture or fault potentially capable of transmitting groundwater through the western (tonalite) ridge is exposed in the excavated slopes, the RWQCB will be notified immediately and by writing within seven days of discovery. At a minimum, if a through-going and non-interconnected fracture or fault capable of transmitting groundwater is discovered, additional groundwater monitoring will be proposed to the RWQCB and the M&RP will be revised accordingly to monitor this zone.

The water quality monitoring program will also include monitoring in the San Luis Rey River valley alluvial prism from compliance well GMW-3 and Lucio Dairy well #2R (located at the Lucio Dairy near the northeastern property boundary). Wells GLA-16 and SLRMWD#34R, (SLRMWD designation), will serve as alluvial "sentry" wells located further downgradient of the facility along the modeled groundwater flowpath (GLA, 1995). Under this monitoring program, the proposed monitoring well network will be maintained throughout the life of the landfill and through the post-closure period. Existing wells, which are not included within the monitoring network but are located within the footprint of the landfill will be properly abandoned prior to landfilling in that area. It should be noted that in the event that facility construction requires the destruction of any of these wells (e.g., a well located in the proposed ancillary facilities area), a replacement well would be constructed in the vicinity of the originally designated well. Table 2 provides a description of the well construction details for the proposed detection monitoring program wells.

<u>Surface Water Monitoring Points</u> - Three surface water monitoring points are proposed. Because there is no evidence of a spring in the canyon and rainwater that would flow into the canyon would have very little time in contact with the surficial soils, sampling from an upstream background location is not possible. . However, surface water monitoring within Gregory Canyon downgradient of the landfill is proposed as an indicator of landfill impacts to surface water. The canyon compliance location will be located toward the mouth of the canyon (GCSW-2), approximately 30 feet north of well GLA-10. To monitor the surface water quality in the San Luis Rey River, surface water sampling locations were selected up- and down-stream of the Gregory Canyon drainage to the San Luis Rey River. The background San Luis Rey River surface water monitoring point (SLRSW-1) will be located in the San Luis Rey River downstream from the Hanson sand and gravel pits. It will provide water quality data for surface water entering the site from the Hanson sand and gravel quarry. The compliance surface water monitoring point (SLRSW-2) will be located downstream of the landfill at a sampling point just east of the proposed access road bridge.

<u>Vadose Zone Monitoring Points</u> – Although groundwater is not expected to seep beneath the landfill, because the landfill is to be placed within a canyon, as prudent engineering, a subdrain system will be installed below the landfill footprint to intercept any groundwater entering the canyon. As designed, groundwater in the subdrain would flow by gravity to a storage tank. In addition, the leak detection/drainage layer located between the upper and lower high density

polyethylene (HDPE) liner systems, will transmit any liquid in this layer by gravity to the LCRS tank by way of an inspection/sampling sump. The subdrain tank and leak detection/drainage layer inspection sump will be monitored quarterly and if groundwater/liquid is present they will be sampled. Peripheral vadose zone monitoring points are unnecessary, because the facility will be fully lined and will have an active landfill gas collection system.

Leachate Monitoring Points - Leachate collected by the LCRS will be sampled at one of the two downgradient tanks.

3.2.2 PROPOSED DETECTION MONITORING PROGRAM FREQUENCY

Groundwater Monitoring - In accordance with CCR Title 27 §20415, the landfill operator will collect samples from the designated monitoring points on a quarterly basis. In addition, as new wells are added to the monitoring program, samples will be collected four to six times per year as necessary to obtain a representative background water quality database for each new well.

Surface Water Monitoring – Surface waters will be sampled and analyzed on a quarterly basis, assuming water is present at the designated surface water monitoring locations.

Vadose Zone Monitoring – Once the landfill has been constructed, the subdrain and leak detection/drainage layers will be monitored quarterly and samples will be collected if water is present.

Leachate Monitoring – Once the landfill begins operation, the pH and electric conductivity of the leachate will be monitored on a continuous basis with an automated probe. The LCRS tank will be sampled annually in October at a minimum for all of the 40 CFR 258 Appendix II COCs. Any constituent identified in the October leachate sample that is not currently included as a water quality monitoring parameter will be included in a retest sampling event in April of the following year. With the exception of heavy metals, which are generally poor indicators of a release, verified COCs, as determined by the April retest, will be added to the list of routine (quarterly) water quality monitoring parameters for the site.

3.3 SAMPLING AND ANALYSIS

Groundwater, surface water and other liquid sampling and analytical methods, decontamination, and sample transfer protocols are described in detail in the Sampling and Analysis Plan (Attachment 1). Depending on the location of the well, two separate sampling procedures are proposed for the GCLF. As a result of the hydraulic barrier system to be employed at the POC, all POC fractured bedrock flow system wells will be sampled in accordance with a well recovery procedure discussed under the Bedrock Compliance Well Sampling Procedures section of the Sampling and Analysis Plan. All other wells (alluvial and bedrock-background/cross-gradient) will be sampled in accordance with the procedures discussed under the standard sampling procedures section.

3.4 MONITORING PARAMETERS

3.4.1 GROUNDWATER MONITORING PARAMETERS

The following groundwater monitoring parameters (MPars) are proposed for the GCLF:

- General Chemistry – Metal surrogates (chloride, nitrate as nitrogen, pH, sulfate, TDS)
- Metals - calcium, magnesium, sodium
- Organics – 40 CFR 258, Appendix I VOCs.

A justification for the above alternative list of MPars (the Appendix I list of constituents, but substituting the metal surrogates for the 15 heavy metals, and the addition of the indicator metals calcium, magnesium and sodium) has been submitted to the RWQCB under separate cover.

Sampling of representative landfill perimeter wells (GLA-2, GLA-4, GLA-5, GLA-10, GLA-11, GLA-12, GLA-13, and GLA-14, and the wells within the San Luis Rey River valley (Lucio #2, SLRMWD #34 and GLA-16), was conducted on a quarterly basis beginning in December 2000 (at least one year prior to the placement of waste at the site in accordance with CCR 27 §20415(e)(6)), to develop an initial database on the water quality prior to landfill activities. Water levels were also measured in each of the wells monthly between November 2000 and December 2001 to establish the highest and lowest anticipated water level.

As described in Section 2.6.3, during the first four quarterly monitoring events (prior to landfill operation), groundwater monitoring wells and surface water monitoring points were sampled for the full suite of "constituents of concern" (COCs) as defined by the Code of Federal Regulations (40 CFR Part 258 Appendix II). As stated in Section 2.6.4 above, existing groundwater and surface water points within the monitoring program will continue to be sampled and tested quarterly for the Appendix I list of constituents (except the metal surrogates will be included in lieu of the 15 heavy metals) and the indicator metals calcium, magnesium and sodium, beginning with the fourth quarter 2004 monitoring period to develop a representative statistical database of background water quality chemistries. Subsequent quarterly monitoring events will continue to include analysis for the above MPars. Additionally, samples will be collected from each media (e.g., groundwater monitoring wells, surface water, drainage layer and subdrain water) every five years, or otherwise in accordance with current CCR Title 27 regulations and tested for the full list of 40 CFR 258 Appendix II COCs.

With the exception of the heavy metals, COCs identified in a sample and verified by retest will be added to the list of routine MPars. In lieu of adding the heavy metals, continued monitoring of the metal surrogates is proposed.

Whenever a new background well is added to the DMP, the new well will be sampled four to six times per year initially to obtain a minimum of four rounds of data for the full 40 CFR 258 Appendix II COCs, and then for the DMP MPars in order to establish the background database for groundwater in the new well for robust statistical analysis.

Implementation of the M&RP requires that the lowest possible detection limits be achieved for each constituent included in the program. For a given laboratory, the Method Detection Limit (MDL) is defined as the lowest concentration at which that laboratory can differentiate with 99% reliability between a sample which contains the constituent and one that does not. Although there are several test methods for analysis of VOCs in water, EPA Method 8260 (utilizing a gas chromatograph and mass spectrophotometry) is recommended because it can be used to identify all 40 CFR Appendix I VOCs.

3.4.2 SURFACE WATER MONITORING PARAMETERS

If present, monitoring of surface water bodies must be performed in accordance with CCR Title 27 §20415(c). Surface water samples will be analyzed for the same indicator monitoring parameters established for groundwater monitoring program.

3.4.3 VADOSE ZONE MONITORING PARAMETERS

Subdrain/Drainage Layer Liquids – Although groundwater/liquid is not expected in the subdrain or drainage layer system, liquids, if present, will be sampled and analyzed for the same indicator monitoring parameters established for groundwater monitoring.

3.4.4 LEACHATE MONITORING PARAMETERS

Leachate – Liquids emanating from the LCRS will be analyzed annually in October at a minimum for the 40 CFR 258, Appendix II list of COCs. With the exception of the heavy metals, which are generally poor indicators of a release, any constituent identified in the October leachate sample that is not currently included as a water quality monitoring parameter and is confirmed to be present by a retest sample collected and analyzed in April of the following year will be added to the list of routine (quarterly) water quality monitoring parameters for the site.

3.5 CONCENTRATION LIMITS AND STATISTICAL ANALYSIS

CCR Title 27 §20400 requires that concentration limits for monitoring parameters be established for the site COCs. The data thus collected will be analyzed for significance using historical statistical comparisons that take into account possible time-dependent trends in the data. As a basis, it is proposed to compare compliance wells with background wells. For the purpose of identifying subtle trends at a local scale, however, a well by well correlation of observed values versus time can be very useful. For one thing, observations from previous sampling periods have a "predictive" value if the data are time-dependent. By establishing a correlation equation and a confidence interval based on the spread of the historical data, the value of the current sampling period can be compared with the predicted interval. If the observed value is larger than the upper limit of the interval, then contamination is reported. If it is not, then it is deemed appropriate to group the current value with the historical data, being that it is internally consistent, and complete a background-to-compliance ANOVA Equivalent analysis.

The ANOVA Equivalent procedure calculates the trends with time of the background and compliance data, and tests the differences between the variance of each compliance well against a trend-corrected estimate of the background standard error. Once a sufficient database has been established, which is expected with the proposed collection of quarterly (or more frequent) samples from existing monitoring points prior to the receipt of waste by the landfill, intrawell statistical analysis will be implemented in lieu of interwell (background-to compliance) tests. Intrawell methods are particularly suited to a non-homogeneous fractured bedrock aquifer such as occurs beneath the proposed GCLF, whereby the naturally occurring constituent concentrations are spatially variable. Under this method a correlation equation is calculated for each well, based on the historical data, and a "normal" range of values is predicted for the following monitoring period. If the value of the last sampling period is inconsistent with the historical data trend, then contamination is suspected. This method is consistent with the statistical technique of prediction intervals recommended by the U.S. EPA and CCR Title 27.

The water quality results for the GCLF will also be evaluated using the VOC Special non-statistical test for VOCs detected less than 10 percent of the time in background samples. A release will be tentatively indicated if either two or more VOCs exceed their respective method detection limits (MDLs) in a sample, or if any single VOC exceeds its practical quantitation limit (PQL). VOC detections will be subjected to verification sampling and analysis in accordance with CCR Title 27 §20420 (j)(1).

3.6 PROPOSED MONITORING FREQUENCY

The proposed routine monitoring program will include quarterly sampling and analysis for the routine monitoring parameters from each monitoring point (surface water, groundwater, and vadose zone subdrain/drainage layer). Now that the proposed monitoring system has been constructed, this program will include the collection of quarterly samples in existing monitoring wells beginning with the fourth quarter 2004, so that a sufficient database is developed for each available well prior to the acceptance of waste by the landfill. In addition, once the facility begins to accept waste, a single COC sample will be collected from each monitoring point every fifth year. Groundwater levels also will be measured quarterly in all monitoring wells and water level measuring stations.

Quarterly groundwater monitoring reports will be prepared to summarize the deterministic and statistical analyses of groundwater flow, groundwater chemistry, and vadose zone chemistry. Annual groundwater monitoring reports will also include time-series plots depicting concentration trends of routine monitoring parameters detected in groundwater.

Quarterly Sampling and Reporting Schedule

Quarter	Sampling Dates	Reporting Date
First Quarter (Winter)	January 1 through 31	April 30
Second Quarter (Spring)	April 1 through 30	July 31
Third Quarter (Summer)	July 1 through 31	October 31
Fourth Quarter (Fall)/Annual	October 1 through 31	January 31

4.0 CLOSURE

The proposed M&RP described herein is based on the regulations contained in CCR Title 27 and 40 CFR 258. The recommendations presented in this report were prepared in accordance with generally accepted professional geotechnical and hydrogeologic principles and practices. This report makes no other warranties, either expressed or implied as to the professional advice or data included in it. Our firm should be notified of any pertinent change in the project, or if conditions are found to differ from those described herein, since this may require a reevaluation of the conclusions and recommendations.